File Catalog: Electron Tube Products
Section: Receiving Tubes

6900
Bendix Type TE-54
(Generic Type 5687)

RELIABLE HARD GLASS MEDIUM MU TWIN TRIODE

(For Pulse Application)

DESCRIPTION

This miniature medium-mu twin triode is one of Bendix Red Bank HY-G-300* reliable vacuum tubes specifically designed for Pulse applications in missiles, aircraft and other military and industrial installations. Freedom from early failures, long average service life and uniform operating characteristics are considered prime requisites for such tubes. In addition to a 45-hour run-in under various overload, vibration and shock conditions, likely to be encountered in service, each tube is tested for its Pulse capabilities under maximum grid-drive and duty-cycle conditions.

Since this tube is designed for use in equipment with high ambient temperatures and where high levels of vibration and shock are encountered, special materials and manufacturing techniques are employed. The hard glass bulb and Tungsten stem seal construction are features found on many high-powered transmitting tubes. Careful exhaust to a high degree of vacuum, with complete out-gassing of all the elements by means of electron bombardment, as well as the usual induction heating, insures maximum life expectancy. These factors, as well as a conservative design center for cathode temperature, permit operation of the 6900 at bulb temperatures up to 300° Centigrade.

The use of ceramic spacers eliminates one of the most common sources of tube failure, which is the evolution of gas from other less costly materials, such as mica. Moreover, ceramic spacers contribute to a much sturdier structure with the use of multi-pillar supports locked together by 12 welded eyelets. Special alloy snubbers, which maintain the mount in position, retain their spring properties at high temperatures, resulting in a structure resistant to shock accelerations as high as 500 G. The rugged pure Tungsten heater is supported in a high density aluminum oxide insulator which permits operation at high Heater-Cathode voltages.

*Registered Trademark.

CHART 1. RATINGS*

Heater Voltage—(AC or DC)**	6.3 volts
Heater Current	1.00 amp.
Plate Voltage—(max.)	600 volts
Max. Peak Cathode Current***	4.5 amps.
Max. Plate Dissipation (per plate)	4.25 watts
Max. Peak Grid Voltage	±100 volts
Max. Heater-Cathode Voltage	100 ±500 volts
Max. Grid Resistance	1.0 megohm
Warm-up Time	45 sec.

(Plate and heater voltage may be applied simultaneously)

*To obtain greatest life expectancy from tube, avoid designs where the tube is subject to all maximum ratings simultaneously.

**Voltage should not fluctuate more than ±5%.

***See Chart 5.

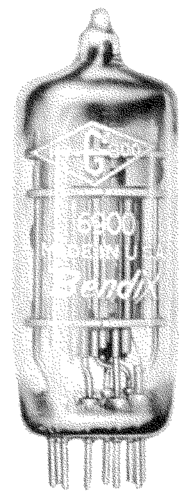


CHART 2. MECHANICAL DATA

Base	9 Pin Miniature Nonex Glass—Gold Plated Pins
Bulb	Nonex Glass—T6 ½
Max. Overall Length	2 ⅝″
Max. Seated Height	1 15/16″ Nom
Max. Diameter	⅞″
Mounting Position	any
Max. Altitude	80,000 feet
Max. Bulb Temperature	300°C
Max. Impact Shock	500 G
Max. Vibrational Acceleration (100 hour shock excited fatigue test, sample basis)	50 G
Life Expectancy	5,000 hrs.

CHART 3. PULSE TEST CONDITIONS AND AVERAGE CHARACTERISTICS

Heater Voltage	6.3 volts
Heater Current	1.00 amp.
Plate Voltage	500 volts
Grid Pulse	+50 volts
Grid Voltage	—100 volts
*Plate Current	4.25 amps.
*Grid Current	.25 amp.
Pulse Time	10 μ sec.
Pulse Repetition Rate	250 pp sec.

*Both sections paralleled (Chart 10)

THE Bendix CORPORATION
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ELECTRICAL CHARACTERISTICS AND TEST DATA

CHART 4. TEST CONDITIONS AND CHARACTERISTICS LIMITS

All Tubes are Stabilized for 45 Hours Under Test Conditions and 2 G Vibration at 30 Cps. Prior to 100% Testing

Heater voltage, E_f .... 6.3 volts
Plate voltage, E_b .... 120 volts
Grid voltage, E_c .... —2.0 volts

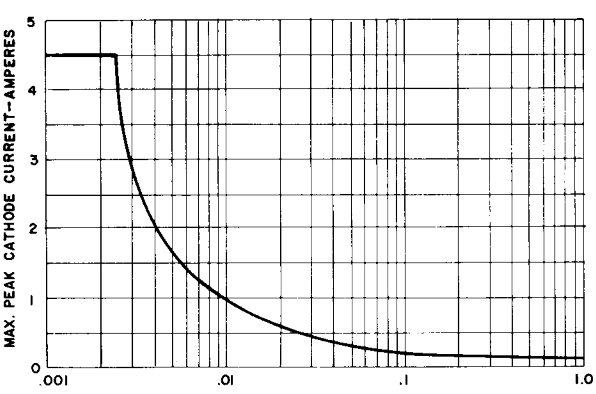
CHARACTERISTIC	SYMBOL	MIN.	DESIGN CENTER	MAX.	UNITS
PRODUCTION TESTS					
Heater Current	If	.950	1.000	1.050	A
Heater-Cathode Leakage	Ihk	—	—	25	μAdc
Grid Current	Ic1	—	—	1.0	μAdc
Plate Current	Ib	25	36	47	mAdc
Transconductance (1)	Sm	8000	11500	15000	μmhos
Transconductance (2) Ec = 5.7	▲Sm	—	—	15	%
Short and Continuity					
DESIGN TESTS					
Insulation of Electrodes					
Eg1-all = —100 Vdc	R	100	—	—	meg
Ep-all = —300 Vdc	R	100	—	—	meg
Cut Off Plate Current					
Ec1 = —25 Vdc Eb = 300	Ib	—	—	2000	μAdc
Ec1 = —55 Vdc Eb = 500	Ib	5	—	500	μAdc
Accelerated Grid Current (Ef = 7.0 V)	Ic1			5.0	μAdc
Primary Plate Emission (Eb = 195 Vac)	Ib			25	μAdc
Amplification Factor	MU	16.0	18.5	21.0	
Vibration Noise Output Ebb = 120 Vdc Ec1 = —2 Vdc Rp = 2000 Swept Frequency = 60-500~ Constant Acceleration = 2.5 G	Ep	—	—	500	mVac
Capicitance (without shield)					
	Cg1-p	2.8	—	5.2	μμf
	Cin	5.0	—	8.0	μμf
	$Cout_1$	0.62	—	0.98	μμf
	$Cout_2$	0.45	—	0.77	μμf
	CHK	2.0	—	4.0	μμf

CHART 6. ADDITIONAL TESTS

In addition to the production and design tests shown in Chart 3 other tests are performed on a sampling basis to assure a high outgoing quality level. See below.

TEST	CONDITIONS	DURATION
Heater Cycling Life Test	On 1 Min. Off 4 Min. Ef = 7.5 Ehk = 300	2,000 On-Off Cycles
Life Test	Under "Pulse Test Conditions"	500 Hours
Life "Expectancy" Test	Under "Pulse Test Conditions"	5,000 Hours
High Level Fatigue Test	2.5 G 60-500 Cycles Swept Frequency	96 Hours
Shock	500 G	20 Impacts
Altitude Test	80,000 Feet	5 Minutes
Glass Strain Test	Boiling Water to Ice Water	15 Seconds in Each
Mount Inspection	100% Test—Miscroscopic Inspection of 30 Possible Trouble Points	

CHART 5. PULSE RATING



DUTY FACTOR (10,000 MICROSECOND AVERAGING TIME) FOR THE 6900 IS DEFINED AS THE RATIO OF "ON" TIME IN MICROSECONDS TO 10,000 MICROSECONDS.

ON TIME IS DEFINED AS THE SUM OF THE DURATION OF ALL INDIVIDUAL PULSES WHICH OCCUR DURING ANY 10,000 MICROSECOND INTERVAL.

CHART 7. AVERAGE CHARACTERISTICS

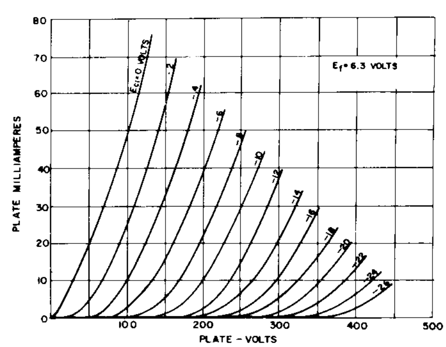
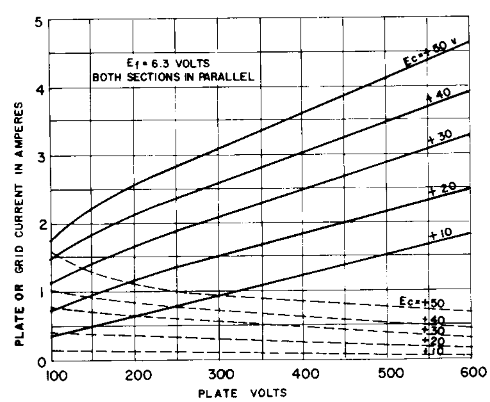


CHART 8. AVERAGE CHARACTERISTICS (PULSE)



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CHART 9.

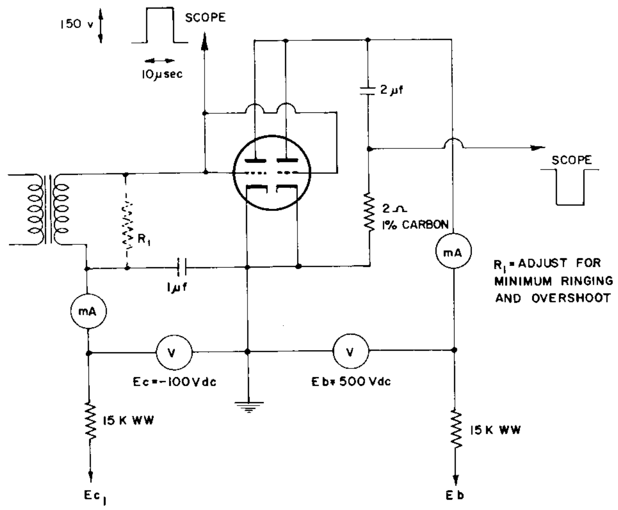
EFFECT ON LIFE OF INCREASED RATINGS (PULSE)

See also Application Notes	OPERATING CONDITIONS		
RATING OR CHARACTERISTICS	CONSERVATIVE	TYPICAL	MAXIMUM
Heater Voltage	6.3 V ± 2%	6.3 V ± 5%	6.3 V ± 10%
Plate Voltage	400 Vdc	500 Vdc	600 Vdc
Plate Current (Av.)*	10 mA	11 mA	14 mA
Plate Dissipation*	4.0 W	5.5 W	8.5 W
H-K Voltage	200 V	350 V	500 V
Grid Resistance	25,000 ohms	75,000 ohms	100,000 ohms
Bulb Temperature	200°C	250°C	300°C
Altitude	0-20,000′	60,000′	80,000′
Vibration	2 G	5 G	10 G
LIFE EXPECTANCY	MAXIMUM	HIGH	MEDIUM

*See Chart 5.

CHART 10.

PULSE TEST CIRCUIT



APPLICATION NOTES

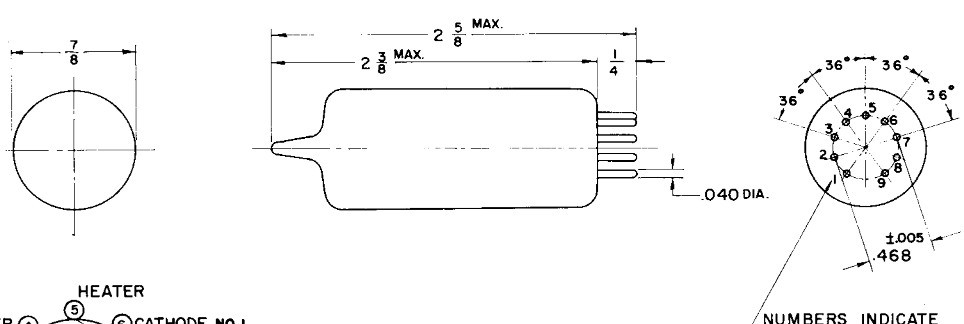
Special attention should be given to the temperatures at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy will be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if absolute maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are directly related to the degree that regulation of the heater voltage is maintained at its center rated value.

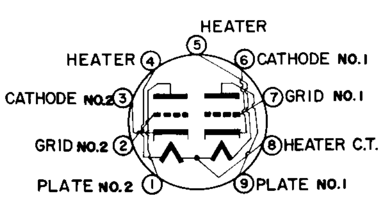
This tube is constructed using nonex glass and thus can withstand higher ambient temperatures in operation. However, the bulb temperature should never exceed 300°C at its hottest point and cooling should be employed if necessitated by the additive effects of operation at high altitudes and high dissipation simultaneously or by other sources of heat in the equipment.

The plate voltage rating and high-perveance of the 6900 make it readily adaptable to varied pulse applications. In order to insure maximum reliability in pulse service the peak cathode current should not exceed the value shown in Chart 5 for the required duty factor.

Chart 9 is presented to emphasize the dangers of operating simultaneously at or near all maxima. In general, the effect on life of operation at increased ratings is additive and cumulative. Interpolation within this chart will give the designer a general idea of the life expectancy and reliability of his application. Each proposed application should be life tested under maximum environmental conditions in order to check that the design gives the desired reliability. When conservatively used this tube has a life expectancy of 5,000 hours.

Chart 10 shows a typical Pulse Test circuit in which every 6900 is tested before shipment. Special exhaust procedures and cathode activation bring the relatively dense emission coating to a high degree of activity to maintain cathode currents under Pulse conditions with practically no "slump" during the life of the tube. The Bendix 6900 can be used with the confident expectation of superior performance in every application now using the 5687.





BASE DIAGRAM

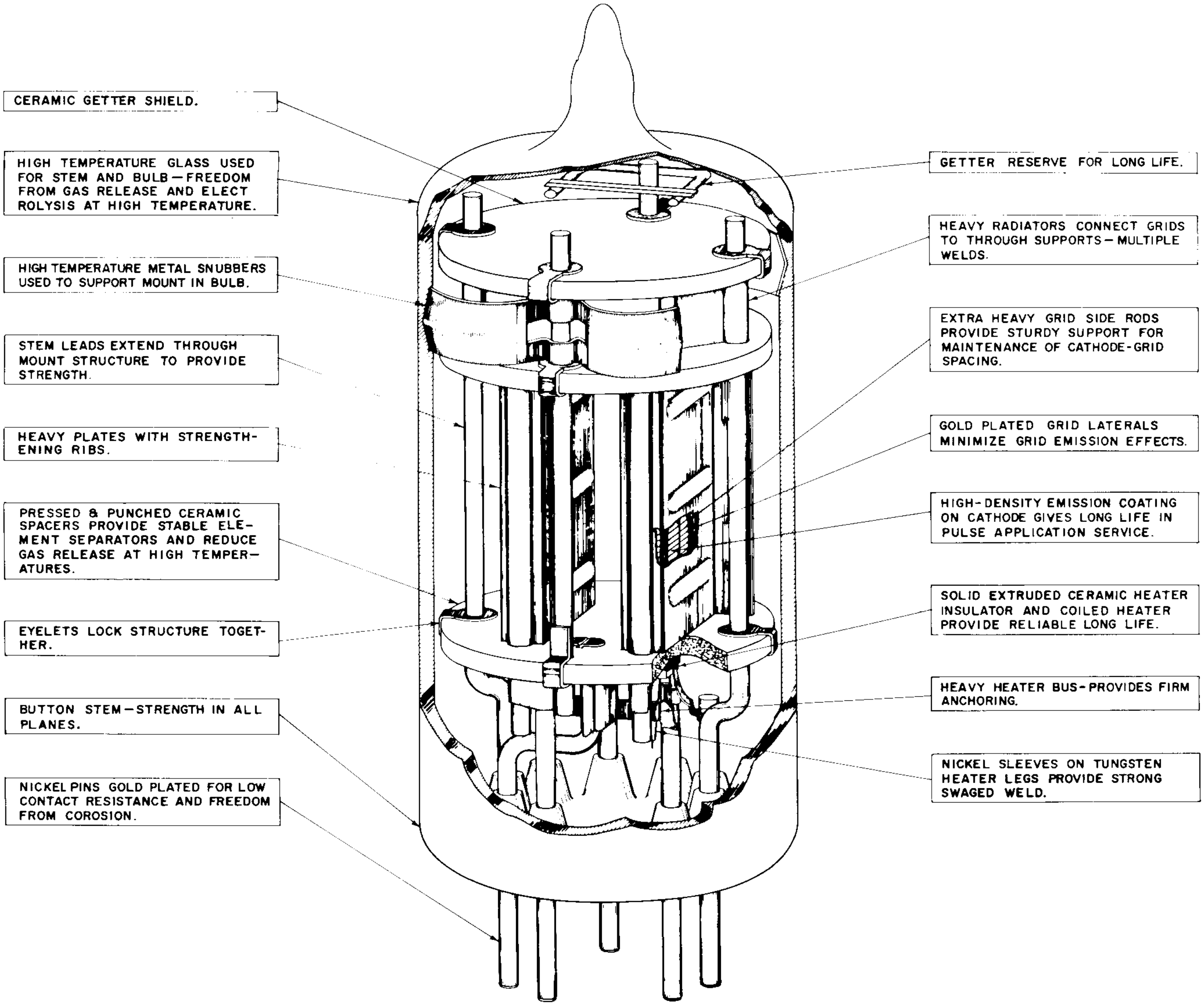
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED.

OUTLINE DRAWING

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STRUCTURAL FEATURES OF 6900 PROVIDE HIGH RELIABILITY AND LONG LIFE.

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Red Bank DIVISION, EATONTOWN, NEW JERSEY

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